

# Open Reduction for Dorsal Dislocation of Second to Fifth Carpometacarpal Joints: A Case Report

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## Abstract

**Background** Fracture-dislocations of all four ulnar (second to fifth) carpometacarpal (CMC) joints are rare hand injuries and frequently overlooked or missed. These injuries can be treated conservatively when closed reduction is successfully achieved, though they are sometimes irreducible and unstable.

**Case Description** We report the case of a 17-year-old boy involved in a vehicular accident. Clinical images showed dorsal dislocation of all four ulnar CMC joints of the left hand associated with a fracture of the base of the fourth metacarpal. Although closed reduction was attempted immediately, the affected joints remained unstable and easily redislocated. Therefore, we performed open reduction and percutaneous fixation of all ulnar CMCs. He showed excellent recovery after 1 year postoperatively, reported no pain, and demonstrated complete grip strength and range of motion of the affected wrist and fingers.

**Literature Review** Accurate clinical diagnosis of this lesion is difficult because of polytrauma, severe swelling masking the dislocated CMC joint deformity, and overlapping of adjacent metacarpals and carpal bones on radiographic examination. As for the treatment strategy, it has yet to obtain a consensus. Some reports value open reduction to guarantee anatomical reduction, and it is definitely needed in the patients with interposed tissues to be removed or with subacute and chronic injuries.

**Clinical Relevance** Delayed diagnosis or treatment could lead to poor outcomes. Therefore, surgeons must be aware that precise preoperative assessment is critical, and anatomical open reduction of interposed bony fragments, like our case, may be required even in an acute phase.

## Keywords

- carpometacarpal joints
- fracture-dislocation
- open reduction
- overlook injury

Fracture-dislocations of the carpometacarpal (CMC) joints are relatively rare hand injuries that represent less than 1% of all lesions of the hand.<sup>1</sup> These injuries typically occur owing to falls, fights, and high-energy traumas, such as falls from a height, car accidents, motorcycle accidents, and automobile-pedestrian crashes.<sup>2–4</sup> Unfortunately, such injuries are frequently overlooked or missed. Delayed diagnosis or treatment of these injuries could lead to poor outcomes, including residual pain, hand dysfunction, deformity, and secondary arthritis.<sup>5–7</sup> CMC joint dislocation can be treated using several measures, including closed reduction with immobilization, closed reduction

with percutaneous fixation, and open reduction with internal fixation. The strategies vary as per the severity and type of injury, the timing of surgery, and whether closed reduction is successful or not.

Herein, we report a rare case presenting with dislocation of all four ulnar CMCs, from the second to the fifth, associated with a fracture of the fourth metacarpal base. In this case, the irreducible and unstable lesion preceded by closed reduction in the acute phase was successfully treated with open reduction of the interposed base fragments of the fourth metacarpal.

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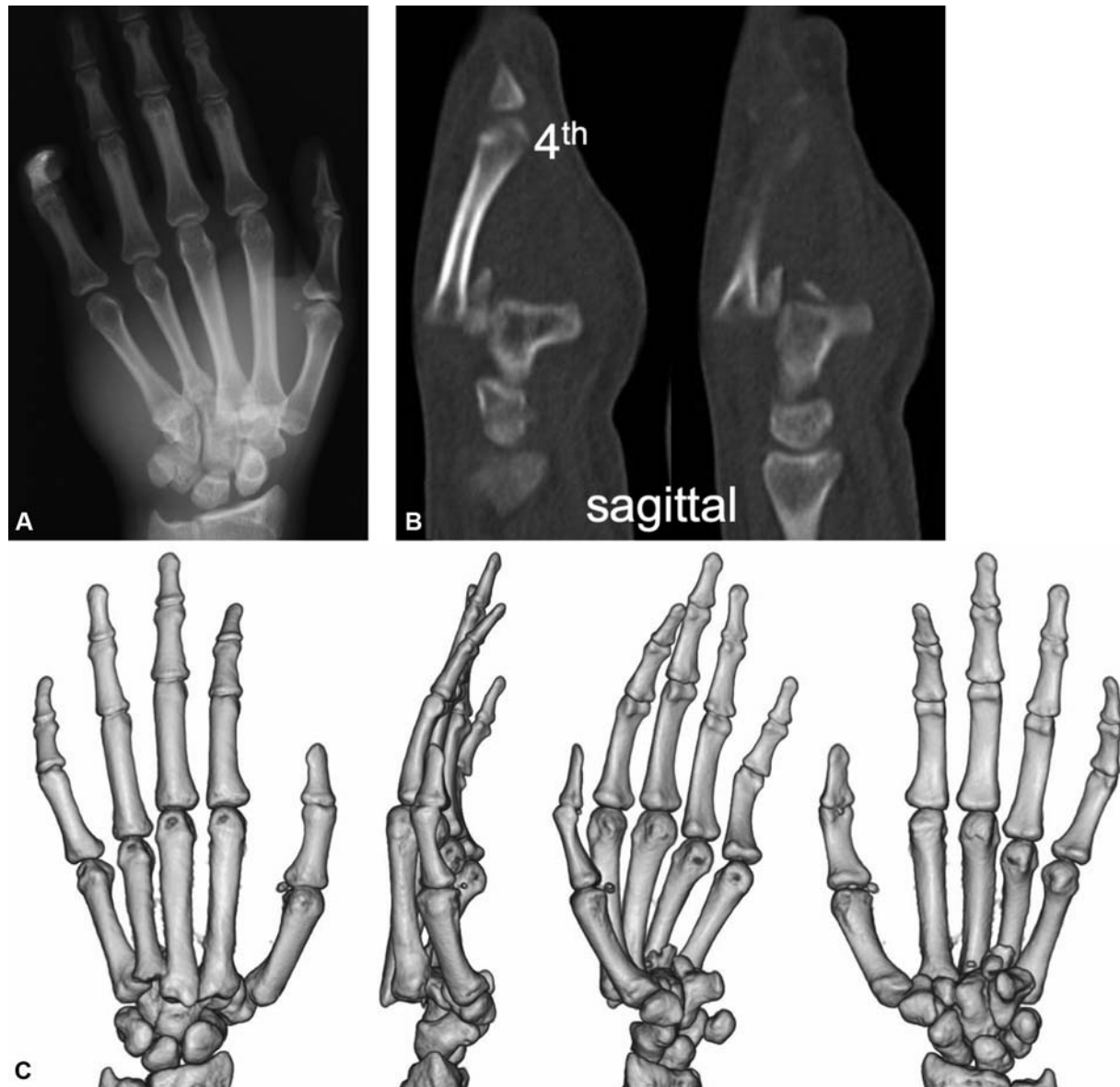
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## Case Report

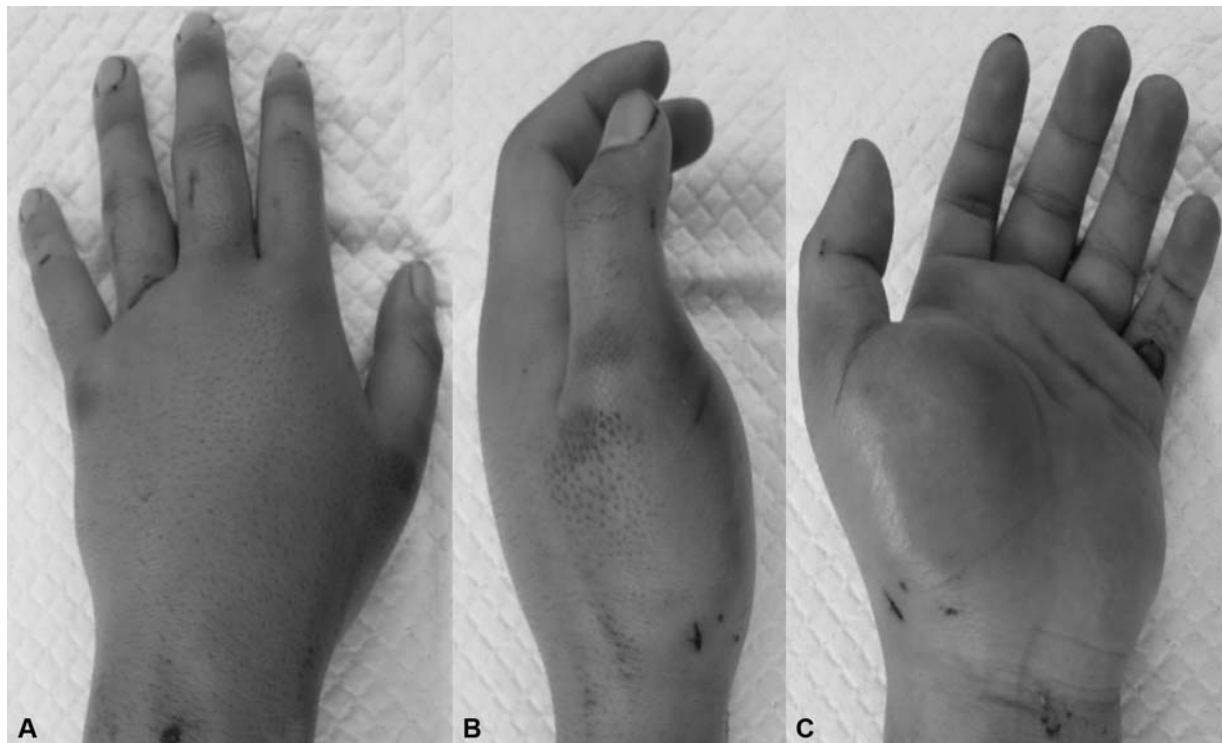
A 17-year-old right-handed boy was involved in a vehicular accident. He was emergently transported to the nearest hospital and was diagnosed with traumatic subarachnoid hemorrhage. He also presented with severe pain and swelling on his left hand. Radiographic examination and a computed tomography (CT) scan of his left hand showed dorsal dislocation of all ulnar CMCs associated with a base fracture of the fourth metacarpal (►Fig. 1). The intracranial lesion was stable and treated conservatively. Simultaneously, he underwent closed reduction for the hand, and the hand was fixed using a dorsal splint on the same day. However, the affected joints remained unstable and easily redislocated because of inadequate reduction. He was then transferred to our hospital for further treatment the next day (►Fig. 2). Under general anesthesia, the patient underwent an intraoperative fluoroscopy, which

revealed a fracture at the base of the fourth metacarpal with dorsal displacement, situated between the fourth metacarpal and carpal bones. Closed reduction probably failed owing to this interposition. We, therefore, performed surgical exposure using a dorsal longitudinal incision. The preoperative images indicated that the base fragments of the fourth metacarpal were dorsally rotated and dislocated. Hence, only longitudinal traction or compression toward the volar side would be insufficient for reduction (►Fig. 3). We then performed an open reduction using an intrafocal leverage technique. After the interposed fragment was dorsally released, anatomical reduction was easily and successfully achieved. Finally, percutaneous fixation of all four CMCs using Kirschner wire ([KW] 1.5 mm) was performed (►Fig. 4).

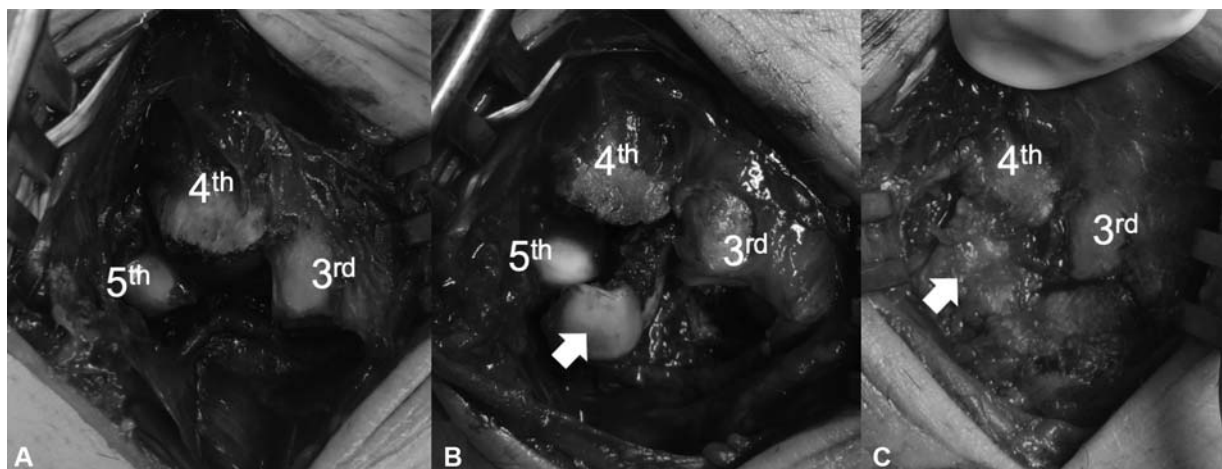
A knuckle cast was used to immobilize the metacarpophalangeal joints for 4 weeks. The KWs were removed 8 weeks after surgery. One year after surgery, he demonstrated



**Fig. 1** (A) An anteroposterior radiographic view (B, C) and computed tomography scan images. (B) Sagittal views (C) and three-dimensional images detected the bony fragments of the fourth metacarpal base.



**Fig. 2** (A–C) Preoperative physical findings of the dorsal, lateral, and volar views. The patient's left hand was severely swollen the day after the injury.



**Fig. 3** Intraoperative findings from the dorsal view. The displaced fourth metacarpal was not reduced (A), and once the interposed base fragment (white arrow) was released (B), anatomical reduction was finally obtained (C).

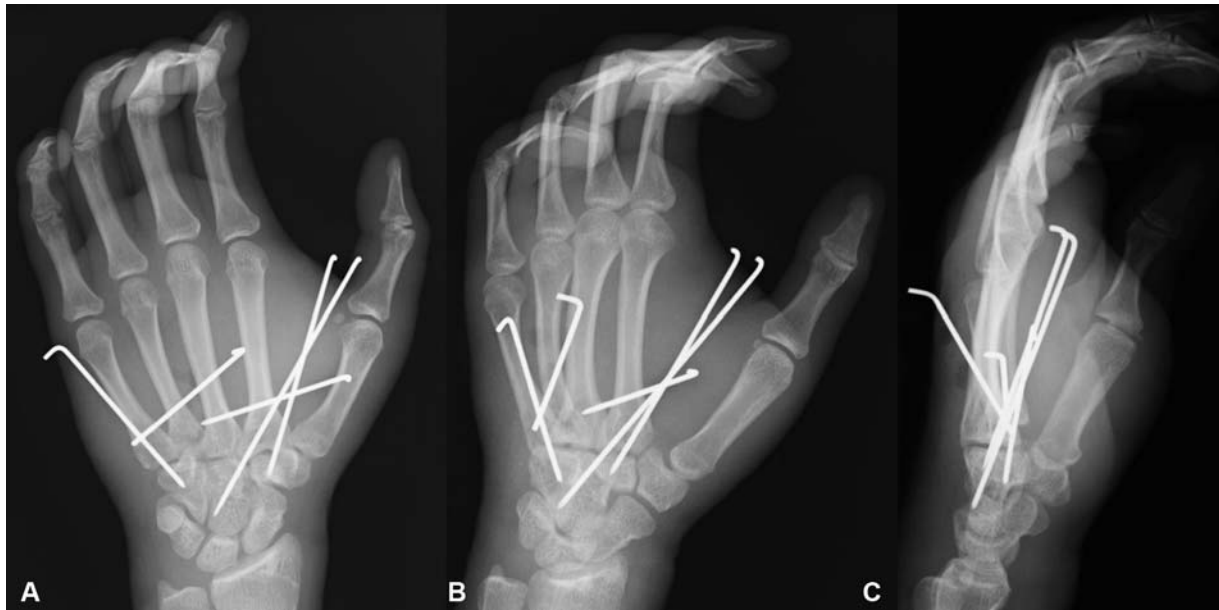
painless full range of motion of all fingers and the wrist and satisfactory grip strength (right hand: 36 kg; left hand: 30 kg). He achieved excellence in the Cooney functional score and scored 0 on the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. Radiographs and CT images demonstrated proper congruity of all ulnar CMC joints and bone union at the fracture site (►Fig. 5).

## Discussion

Dislocation of all four ulnar CMC joints is rare. Although there are some case reports on such occurrences, the frequency is still undocumented. According to past reports, more than three contiguous CMC fracture-dislocations are more often

associated with very high-energy trauma,<sup>4,8</sup> as was seen in our case. The most possible dynamic mechanism of ulnar CMC joint dislocations is a blow with a closed fist, which causes an axial load and shear stress that could result in fracture-dislocation as well as a ligamentous avulsion.<sup>9,10</sup> Dorsal dislocations occur much more frequently than volar dislocations because CMC joints are anatomically aligned such that they demonstrate instability in the dorsal direction.<sup>11</sup> Although divergent dislocations could occur, they are much rarer and more exceptional.<sup>10,12</sup>

Accurate clinical diagnosis at the time of the initial visit could be difficult because it is seen in cases of acute poly-trauma, with severe swelling of the hand masking the dislocated CMC joint deformity. Moreover, the overlapping of



**Fig. 4** (A–C) Postoperative radiographs. Direct visualization of congruent four carpometacarpal joints, 1.5-mm Kirschner wires were inserted percutaneously.



**Fig. 5** Image findings of the hand in the final follow-up period. (A) Anteroposterior and lateral radiographic views and (B) coronal and (C) sagittal computed tomography scans described the sustained anatomical congruity of all affected joints.

adjacent metacarpals and carpal bones may also make it difficult to observe on radiographic examination. Henderson and Arafa described that 15 (71%) of 21 patients with CMC joint dislocations were missed when they first presented.<sup>2</sup>

Even though the presence of CMC joint dislocations is possibly diagnosed by radiographs, accompanying fractures of the metacarpal base or the distal carpal row are still obscure. Thin-slice CT images are strongly recommended for quick



and accurate diagnosis.<sup>11</sup> They provide doctors with affluent information of the lesion such that a treatment strategy can be planned at the earliest. Steinmetz et al reported that delay in diagnosis and treatment could lead to residual subluxation; therefore, precise diagnosis and treatment in the acute period allow for easier reduction.<sup>4</sup>

Treatment for fracture-dislocations of ulnar CMC joints has been debated in the literature, and it has yet to obtain a consensus. When these injuries are diagnosed accurately and are acute injuries, some reports support conservative management.<sup>13,14</sup> Conversely, Kjaer-Petersen et al described the disadvantage of closed reduction with casting that could result in inadequate reduction of fracture-dislocations of the fifth CMC joint.<sup>3</sup> Anatomically, the range of motion increases from the second to fifth CMC joints as the joint goes from radial to ulnar. The fifth CMC joint has the greatest overall range of motion; it can simultaneously flex and adduct.<sup>15,16</sup> El-Shennawy et al analyzed the kinematics of the ulnar CMC joints using motion analysis and three-dimensional CT images.<sup>16</sup> According to their research, the flexion/extension motions of the second and third CMC joints (11 and 7 degrees) were described to be more limited than those of the fourth and fifth CMC joints (20 and 27 degrees), even more so in radioulnar deviation and pronosupination motion as well. Therefore, the fourth and fifth CMC joint dislocations may be prone to inadequate reduction with conservative treatment using a splint or cast. Because of that, all four ulnar CMCs must be rigidly fixed using KW or other fixators. Whether open reduction is needed or not depends on the results of closed reduction. In acute periods, closed reduction is often successfully achieved; meanwhile, some authors recommended an open approach to guarantee anatomical reduction.<sup>6,8,12,17</sup> In particular, open reduction is definitely needed when there are interposed tissues to be removed<sup>8,18</sup> or when closed reduction is unsuccessful in patients with subacute and chronic injuries.<sup>4,19</sup> In our case, the dislocation did not reduce because of the interposed displaced fourth metacarpal base fragments. Therefore, direct anatomical reduction of the fragment with open reduction was necessary. This direct exploration enabled us to eliminate interposed tissues, reduce the dislocation or displacement easily, and also confirm accurate congruity of the joint. Although many surgeons may prefer closed reduction and hesitate to convert it to open reduction, we believe that the strategy of open reduction should be considered for obtaining anatomical reduction and precise congruity.

In summary, we demonstrated treatment of a case with the rare injury of dorsal fracture-dislocation of all four ulnar CMC joints. Closed reduction was unsuccessful, even though the patient was in an acute condition because of displaced fourth metacarpal base fragments. Using open reduction and rigid KW fixation, excellent outcomes were obtained. In such injuries, precise preoperative assessment using CT scans is of great value, and anatomical open reduction is strongly recommended.

#### Ethical Approval

Informed consent was obtained from the patient and his parents for publication.

#### Funding

None.

#### Conflict of Interest

None declared.

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